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Homogenization of global radiosonde humidity data

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Abstract: Humidity data from balloon-borne radiosondes provide the longest record (for the last six decades or so) with high vertical resolution and near world-wide coverage; however, its usefulness in climate studies and atmospheric reanalyses is limited, in part, by changes in sensor characteristics over time and space that often induce large spurious changes. Therefore, it is imperative to homogenize the radiosonde data before they can be reliably used for climate studies and global reanalyses. Extensive research has been devoted to homogenize global radiosonde temperature data, which have played a crucial role in reconciling differences in tropospheric temperature trends and improving atmospheric reanalysis. However, no comparative efforts have been made to homogenize global radiosonde humidity data.

The main goal of this proposal is to homogenize radiosonde humidity data from individual soundings from 1958 to present over the globe and produce a reliable humidity dataset for community use. First, we will start with compiling a comprehensive global radiosonde dataset from several different sources, including data from synoptic radiosondes and field campaigns. Second, the project will focus on developing a rigorous approach to detect non-climatic changepoints in radiosonde humidity time series, including testing different variables such as dew point depression and relative humidity as well as other difference time series using various detection methods. The detected changepoints will be validated against a comprehensive metadata database generated from different sources by this project. Third, adjustments will be made to the time series to homogenize the data. This step will begin with applying physical and empirical correction methods developed for recent radiosondes (by comparing with GPS measurements, for example) to produce more accurate data for most recent years. Then statistical homogeneity adjustment methods will be used to remove the remaining inhomogeneities that could not be adjusted empirically. Fourth, both the original and homogenized data along with the metadata will be archived and distributed by NCAR and other data centers for wide community use, including applications in future atmospheric reanalysis efforts. Finally, the homogenized data will be analyzed to quantify global humidity trends.

The proposed work will produce a reliable humidity data set that will help quantify water vapor trends under global warming. Combined with the already homogenized upper-air temperature data, our humidity data will ensure that future atmospheric reanalyses will have a much improved input data set that is necessary for their applications in climate change studies.